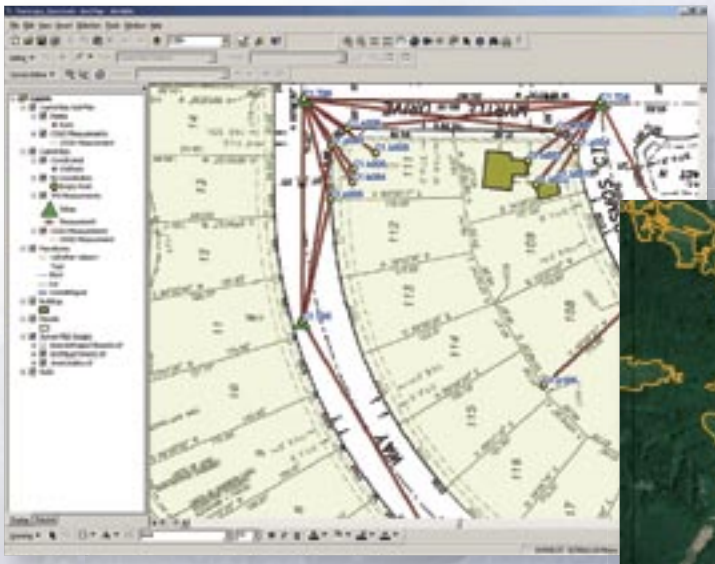
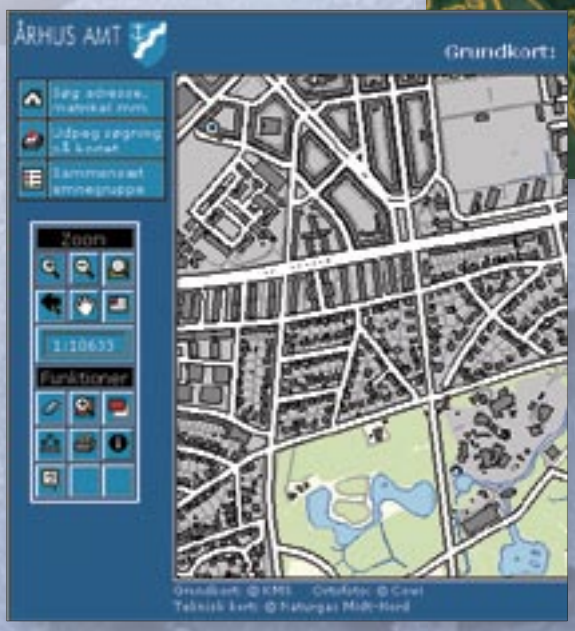
GIS for Cadastre Management

ESRI® GIS Technology in Europe





MAPPING

OWNERSHIP

VALUATION

COMPLIANCE

E-GOVERNMENT

ESRI

GIS for Cadastre Management

The Framework for Cadastre Systems

Since 1969, ESRI, a pioneer in geoprocessing tools, has been helping people solve real-world geographic problems. Today, more than 100,000 organizations around the world use ESRI® software because it uses leading ideas in technology for geographic information management.

Many European countries are developing new strategies to improve cadastre management. Geographic information system (GIS) technology offers cadastres a method of quickly accessing and producing maps, leveraging database information, and automating enterprise work processes.

Because ESRI's GIS software is an open system that conforms to information technology standards, it adapts to a variety of cadastre systems and responds to endless combinations of requirements and operations. The vocation of the cadastre for all countries has become multipurpose: serving administrative mandates, maintaining an up-to-date database, assigning values for taxation, calculating subsidies, addressing rural development and agrarian management, and providing products and services to citizens and companies. GIS helps land information agencies fulfill a variety of these services, from producing specialized maps to providing complex schemes for integrating and delivering spatial data services under the modern mode of e-government.

Survey

Cadastral Mapping

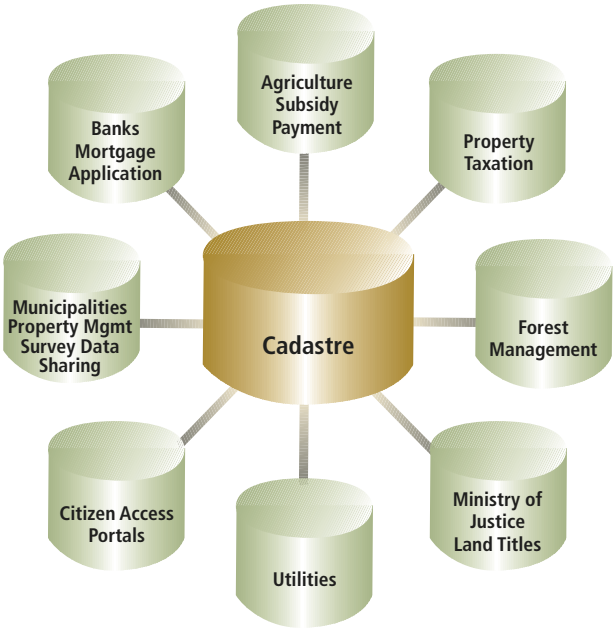
Land Records

Valuation

Real Estate

E-Government

Providing a Foundation for Stability and Prosperity



The multipurpose cadastre uses GIS to access and process data throughout public and private organisations.

Data layers make cadastre information useful for many purposes such as zoning.

An effective and secure real property administration system is essential for the welfare of a country's economy. Governments at all levels require accurate and current land records for mapping the location and extent of landholdings, establishing the ownership of rights in real property, and determining the value of those rights.

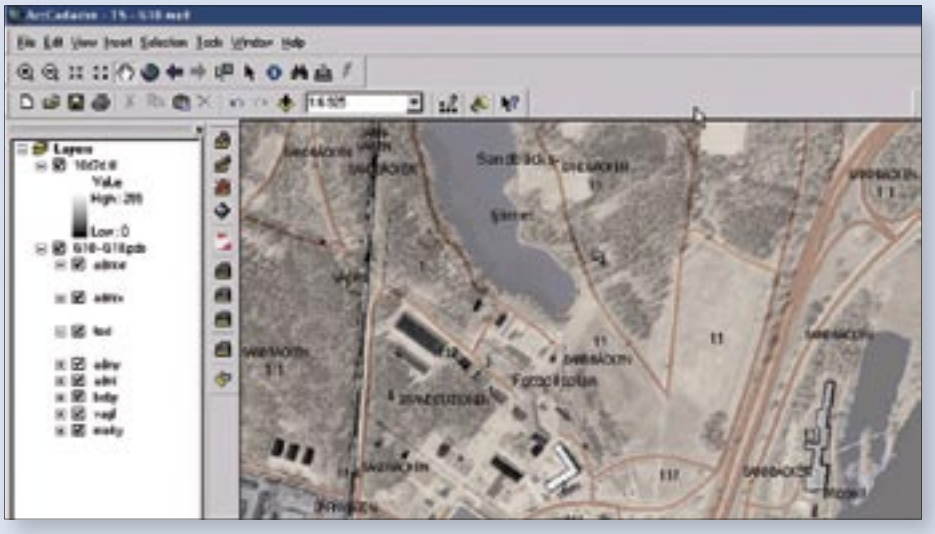
Many European countries' cadastres have a direct relationship with land register offices. The service of register is dedicated to guaranteeing real estate property rights, one of the basic pillars in a market society. The cadastre offers a basic infrastructure that supports different social and economic purposes. Cadastres work in harmony with land register agencies by providing graphic support. Other cadastre objectives are to support land policies, fiscal policies, and agricultural management.

Some countries are creating National Spatial Data Infrastructures that serve as geospatial information warehouses. The cadastre is one of the base layers of a National Spatial Data Infrastructure. ESRI has a well-documented history of working with the international GIS community to develop these national architectures for geospatial database access.

By building the architecture for shared data on standards, users can access and use data in their own GIS. A spatial data infrastructure using ESRI's standards-based software can facilitate sharing information on an enormous scale. ArcGIS® tools can be used in a country's spatial data infrastructure to provide client access; create, manage, and serve metadata (support standards); and create, manage, and serve GIS information.

ESRI continues work with the international community in defining data standards. For European cadastres to work in harmony with agencies within their own nations and to integrate projects on the international level, an adherence to standards in database design and GIS is needed. This supports interoperability of information systems so that nations can leverage the value of geospatial databases for policy making, cost-effectiveness, work flow improvement, and service.

Automated Work Flow



ArcCadastre offers GIS routines for cadastre management.

Case Study—Sweden

Lantmäteriet is responsible for Sweden's cadastral services, managing information for approximately 3.2 million properties. At the end of the 1990s, Lantmäteriet initiated a reformation of Sweden's cadastre system to improve the efficiency of cadastre procedures. The reformation included both new technology and new working methods. As a result, Lantmäteriet has reduced costs 10 to 15 percent and the time required to carry out cadastral procedures by 30 percent. Improvements to the system's productivity include new technical support routines and modern field surveying methods based on global positioning systems (GPS) and GIS.

In a cadastre, procedure documents are created to provide a geometrical description of property formation. Much of this work is time consuming with repetitive similar routines for different jobs. Lantmäteriet developed ArcCadastre based on ArcGIS, to introduce new GIS functions for managing and handling cadastral procedures and map data. Software users put ArcCadastre to work in a unified production line from fieldwork and computation to data processing and documents to the final storage of the data in an object-oriented database environment.

All work in ArcCadastre is done within the framework of a job and steered and monitored with the help of work flows. For example, a work flow can be designed to ensure that legally defined procedures are followed. Deviation will cause the process to stop and wait for approval. The simplest form of work flow is a checklist.

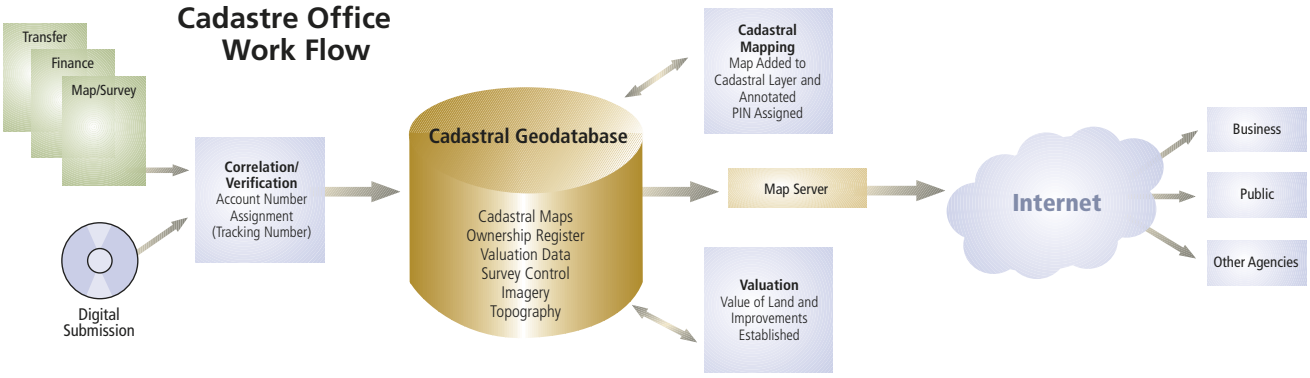
More sophisticated work flows steer the user through different steps in a prescribed manner. User specific work flows can be developed by customization.

ArcCadastre has allowed Lantmäteriet to be more efficient in job management. Commands from a particular job are automatically stored and are available the next time the job is opened. Users who are new to the software can easily begin working with a project and successfully find their place in a project's work flow.

Lantmäteriet has applied ArcCadastre to the following:

- Real property formation
- Production of cadastral index maps
- Public utilities mapping
- Surveying and mapping
- Property management
- Property tax assessment and property valuation
- National, regional, and local planning

Digital maps are becoming increasingly available as Swedish map archives are successively scanned and added to the geodatabase. Less bound by routine, Swedish cadastral professionals using ArcCadastre are free to complete professional demands.



Enhancing Work Flow

From data processing to cartography, automated work flow is modeled and carried out in GIS to improve accuracy and quality and to save labor, time, and money.

Enhancing the Entire Work Flow

GIS provides an integrated work flow for creating and updating the parcel fabric that can be easily shared both within and between organizations.

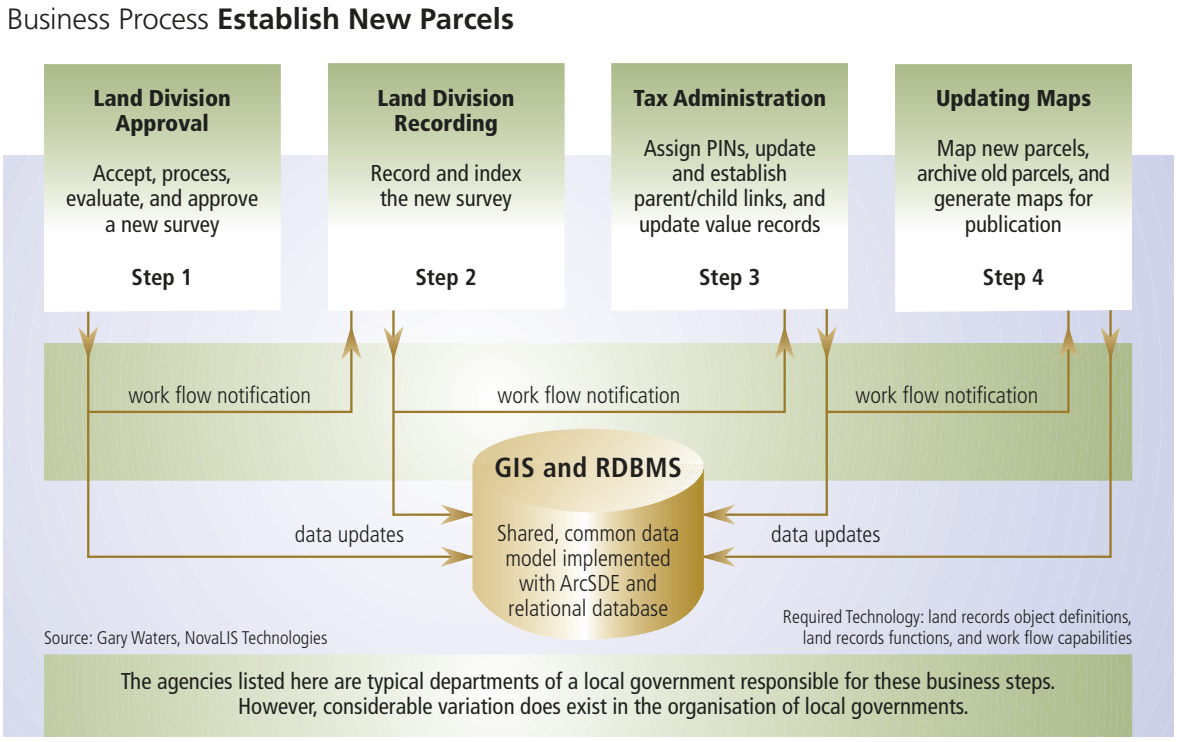
The ESRI family of software works together to handle the entire work flow from data creation to information distribution in an environment that supports information technology (IT) standards and interoperability with existing systems. Enterprise GIS, with the geodatabase, data models, and an array of applications on desktop server and thin clients, is revolutionizing land records management.

More Data Options

ArcGIS can read many native formats and contains many data conversion and geoprocessing tools. ArcPad® takes data gathering and verification into the field and uses wireless technologies to enhance the speed of data updates. The ArcScan™ for ArcGIS extension supplies straightforward and controlled vectorization of scanned documents and works with the spatial tools available in core ArcGIS such as speed parcel editing functions.

Incorporating Survey Data

A new data type available with the ArcGIS Survey Analyst extension allows surveyors and engineers to build a survey information system within ArcGIS. Survey data is stored and managed by ArcCatalog™ but maintained separately from GIS layers; however, these GIS layers can still be edited using survey data. Existing spatial data can be made more accurate on an incremental basis that does not disrupt the work flow.



Data Interchange Between Land Records Office and Local Agencies

Case Study—Italy

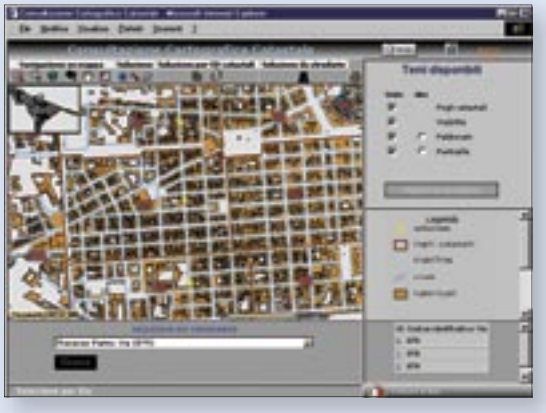
Italy's cadastre information is managed by the Ministry of Finance–Department of Territory. Italy's current modernisation initiatives mandate information exchange between agencies. Therefore, the Ministry of Finance has implemented a cadastre spatial data exchange system using GIS technologies that support sharing information between central and local agencies.

An exchange module called the Catasto–Cumini Interchange System facilitates a continuous information connection between cadastral and municipal offices. Staff can update information and obtain cartographic information about territories by browsing and querying maps owned by individual offices.

Find a Parcel

Cadastral indicators, such as session, sheet, cadastre system, and identification number, are used to find and retrieve parcels information. The user can access census property information and add that data to the map.

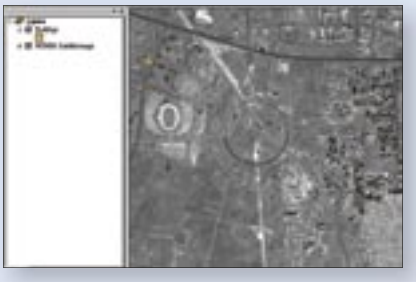
Select a Street



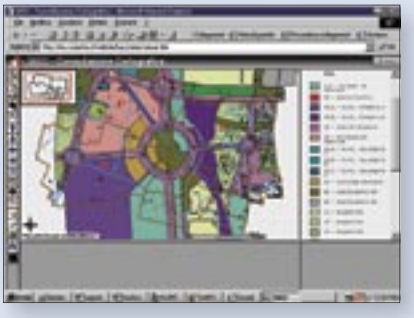
The user can select a street to locate all nearby buildings and parcels. The selected street is then shown on the map through points. The user can zoom on this portion of the map, locate one or more properties of interest, and perform additional queries.

The spatial data engine software ArcSDE®, which facilitates storing and managing spatial data in a relational database management system, manages the interchange database. This makes it possible for users to directly edit data stored in the relational database management system. A server that provides Internet mapping service and has an authoring environment, ArcIMS® makes it possible to publish maps on the Internet using ArcGIS advanced cartography tools.

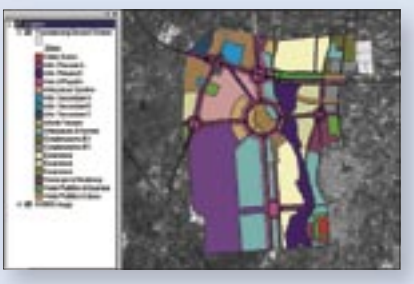
Italy's first municipal departments to work with the Catasto–Cumini Interchange System were the urban planning, topographic naming, and fiscal fee departments. The population registry office will soon be joining the project. The Department of Territory is adding value to the services by providing access stations for government professionals and notary publics.



The IKONOS satellite view of the territory is shown in combination with the buildings' cadastral layer. The transparent layer represents the town planning general scheme.



The town planning general scheme (municipally owned information) is shown in combination with the cadastral layer of buildings.



The town planning general scheme is overlaid on the IKONOS satellite image.

Building a Framework for Managing Resources

Contributing to Economic Health

Valuation and taxation systems based on land records are key contributors to economic well being. Real property value is used to raise capital for building infrastructure, purchasing additional property, starting businesses, and maintaining other capital-intensive activities. Internet GIS makes parcel information and maps readily available to the public, businesses, and other agencies.

By linking maps and legal descriptions to landownership records, GIS provides an efficient method for identifying fraudulent claims or errors in land recording. A GIS-based work flow that uses the topology tools in ArcGIS helps eliminate errors resulting from overlapping boundaries, incomplete parcel descriptions, and other discrepancies in land records.

Topology tools in ArcGIS help eliminate errors resulting from overlapping boundaries, incomplete parcel descriptions, and other discrepancies in land records.

Value of Modeling

A cadastre derives more benefit from GIS by extending its purposes. For example, central and local governments can use land valuation models applied to the cadastre database to support land market values and assess taxation fees.

Multiuse Cadastre

A European multipurpose cadastre may include fiscal cadastre (for tax reference), legal cadastre (title registry), planning cadastre (city planning), and so forth. Common denominators in these types of cadastres are the unambiguous identification of spatial property and a standardised numbering scheme that is uniformly referenced. This identification method allows different vertical application areas, such as taxation, legal, and planning offices, to refer to the same real property. Thus, when the fiscal cadastre promulgates a change on the tax record of a specific parcel, a GIS map shows the tax information changes on the same parcel for the legal cadastre.

GIS can integrate data, such as aerial and satellite imagery, that is a good source of current related information such as crop extent, new construction, flood hazards, and surface permeability.

Going Global

Cadastre information is often considered one of the essential data sets for modernizing government services. The organization of GIS data and applications throughout a country is commonly called a National Spatial Data Infrastructure (NSDI). ESRI's ArcGIS family of products provides the technology for building and managing data and applications and for deploying them on the Internet and Intranet. During the past decade, a network of organizations from around the world has begun to collaborate on a Global Spatial Data Infrastructure (GSDI) supporting the publishing of an open global library of digital geographic information.

Land Valuation

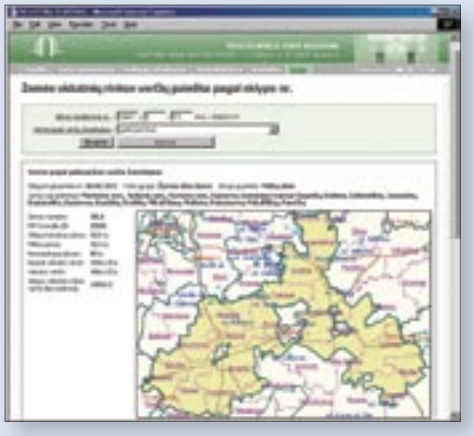
Lithuania Value System automatically calculates tax formulas in a GIS model.

Case Study—Lithuania

Lithuania uses GIS for cadastre management and extends this technology and database management to compute land valuation. The State Land Cadastre Enterprise first formed its special GIS group in 1993. The group produced its first digital cadastral maps using ArcInfo®. In 1997, the State Enterprise Centre of Register (SECR) began to integrate all of Lithuania's real estate records and cadastre data into one system. Data from the land register and data on buildings, constructions, premises, and apartments were integrated into a single real property information system. Legal, technical, and geographical records are managed in a single system under a single organization.

Today SECR's GIS department uses ArcGIS to design applications that transform data from local coordinate systems to the national system. GIS is used to administer the central database, integrate data with attributes, and provide maps on the Internet. Thirty-three layers of data are maintained with ArcSDE including administrative boundaries, buildings' center points, address points, real property value zones, topographic objects, land use, standard map sheets, and orthophoto maps.

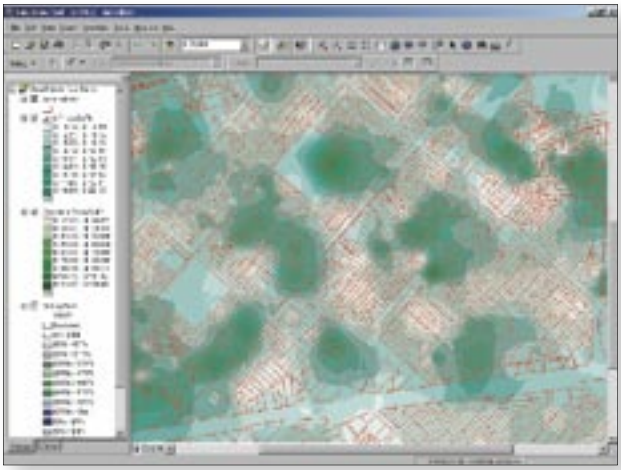
SECR also performs appraisals of real property. The valuation system strengthens real estate markets and supports value-based taxation. GIS is an important component of the mass appraisal system. By accessing parcel, register, and market information from a single database the appraisal system is used to compute mass-values for property located in territories based on prescribed principles within a defined timeframe using updated market data. It also allows for periodic reevaluation of property values in response to market changes.



Land parcel data is grouped by characteristics essential to land market value: value zones, purpose of use, agricultural land, size of the land parcel, productivity grade, and recreational use. These valuations are shown on a GIS map, and the user can access more information in the database through the map or through textual query.

SECR's GIS facilitates the inclusion of many factors in the model. Tax formulas can be automatically applied and computed. The system is easily updated to reflect market dynamics and change in ownership. Quality control is ensured by comparing sales costs and appropriate values. Because GIS is database driven, it can access data related to properties and calculate values using the tax model. The model can be updated to reflect current tax fees and laws.

The mass land valuation uses minimum additional technical, human, and financial resources; saves time; and produces quality valuation results. Land value maps and land parcel valuation models respect market valuation and changes in tax legislation.



Spatial analysis tools that generate value surfaces expedite these types of monitoring tasks.

A Vertically Integrated System

Support for common data format and information technology standards means that GIS helps government agencies integrate information from many sources. These agencies must also ensure that the boundaries of adjacent regional jurisdictions align. Topology and spatial editing tools speed parcel edit and safeguard the integrity of the parcel fabric.

Focusing on Valuation

Land records management may include local or central government valuation activities. One goal of the valuation process is to identify and investigate anomalies in value. ArcGIS supplies spatial analysis tools that generate value surfaces to expedite these types of monitoring tasks.

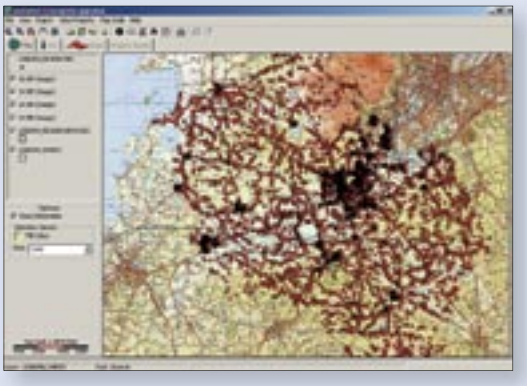
Benefits for an Enterprise Cadastral System

ArcGIS supports all major cadastral applications and supplies a comprehensive solution for converting, editing, mapping, managing, analyzing, and disseminating land records data.

The geodatabase design allows the development of common data models that provide a standardised method for developing and exchanging data. The ArcGIS Land Parcel data model captures the collective experience gained from more than 20 years of managing parcels using GIS. This flexible and object-based model accommodates a range of applications and parcel definitions.

Versioning Data Sets

Versioning in the geodatabase allows multiuser editing, history management, and disconnected editing and provides replication solutions to manage large-scale GIS. Versioning also allows agencies to supply tailored versions of the data to different levels of government and the public.



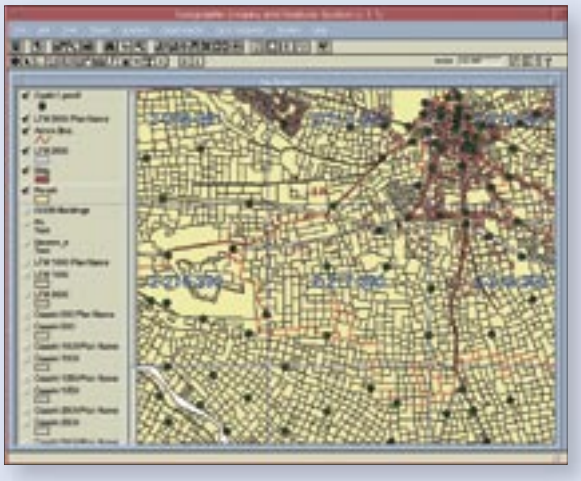
The Assessment Office viewer displays the property's CAMA detail. Map data is served through ArcSDE.

Case Study—Northern Ireland

Valuation and Lands Agency (VLA) in Belfast, Northern Ireland, uses GIS for the domestic revaluation of more than 700,000 parcels. The computer-assisted mass appraisal (CAMA) system built on ArcGIS is being implemented by NovaLIS Technologies, along with partners CDC, AGJD Associated Agents Ltd., and ESRI (UK) Ltd. The outcome of their efforts is a robust system for valuation that includes a GIS-based valuation toolset that allows the dynamics of real patterns and trends to be accommodated within the modeling process.

The VLA CAMA system is intended to be the foundation for the collection of taxes. The system will also provide VLA with the ability to associate all property characteristics and ownership information directly to the parcels of land in Northern Ireland. Statistical models are integrated into the solution to support VLA personnel with assessing the market value for properties. Northern Ireland assessment officials will use the system to provide mass appraisal techniques to their domestic revaluation for 2006.

GIS for Multipurpose Cadastres



Cassini map shows parcels and buildings.

Case Study—Cyprus

The Cyprus Department of Lands and Surveys (DLS) operates multipurpose cadastres partially on a manual and partially on a computerized basis. The department records a considerable amount of land-related data. Cadastral plans are widely used as a fundamental graphic record by a wide range of agencies. Information about development, utilities, land use, water resources, geology, and even statistical data for population, industry, agriculture, and planning are recorded on, or closely related to, the cadastral plans.

The DLS is performing a systematic resurvey of Cyprus and uses this data to establish a fixed boundary coordinate cadastre system. The geodatabase includes land records, cadastral plans, and topographical maps. Various business systems are being used to support the survey, registration, valuation, and management functions of the DLS. This sets up the context for developing and implementing a GIS called Cyprus Integrated Land Information System (CILIS) where all agencies with land-related activities can share available data.

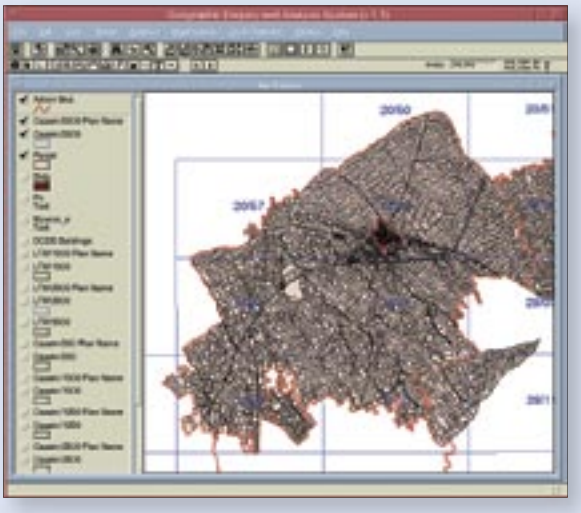
The survey database, the digital cadastral database, and the topographical database constitute the spatial database of CILIS. The survey database (SDB) stores information related to the geodetic network and survey data. The SDB is the repository of data from original source records of surveys that underpin the cadastral framework. It is also the reference system for applications that require dimensions or accurate survey coordinates. SDB contains the foundation data for the digital cadastral database (DCDB).

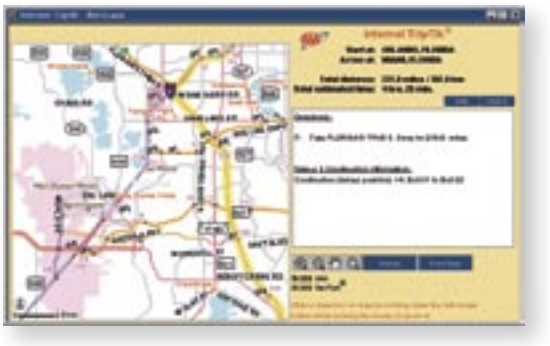
The DCDB has been designed to provide an up-to-date, continuous cadastral map base to support cadastral mapping and the land information system functions. The database stores the current cadastral framework, thematic overlays, and topographic data in a seamless form.

Spatial applications are based on ArcInfo, ArcView®, and other ESRI GIS products and relational database management system technology, surveying packages, and computer-aided design.

CILIS facilitates land transactions, improves and accelerates valuation assessments, reduces duplication of land administration work among government agencies, and increases the ability of government to effectively manage state lands and expedite acquisition and requisition orders.

The Cyprus Integrated Land Information System shows information for individual property units.





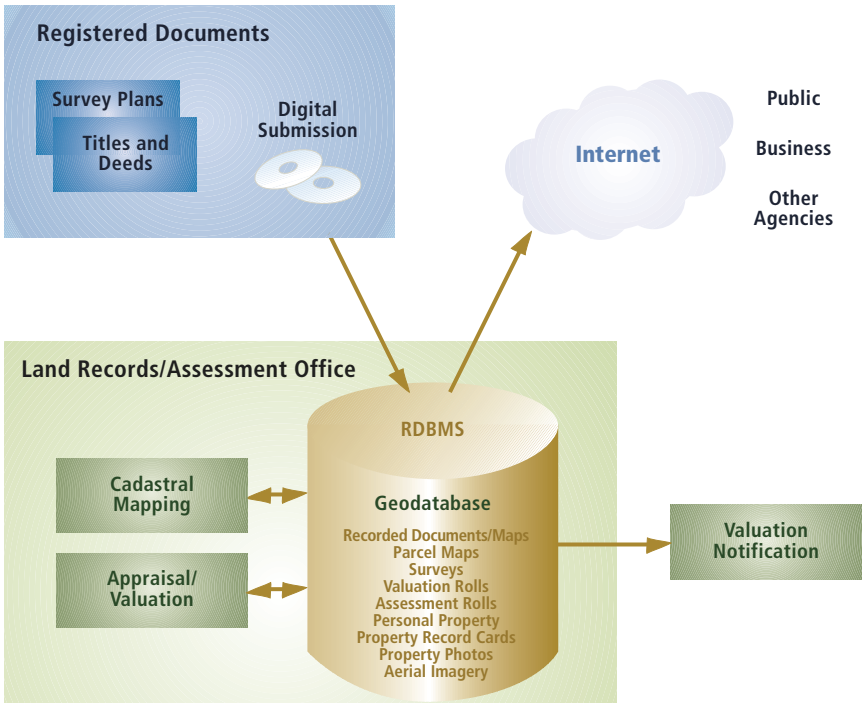
Integrating survey data in GIS through the use of ArcGIS Survey Analyst allows local and national governments and private surveying contractors to incrementally improve the accuracy of spatial data.

Use Accurate Data

The most detailed land records data is maintained at the parcel level by local and regional authorities. These offices use GIS to assist in the maintenance of ownership deeds and titles; planimetrics; orthophotos and/or satellite imagery; and topographic, flood delineation, land cover, and land use maps.

Toward Accurate Land Records

European cadastres often are multipurpose and can include a fiscal register, legal cadastre, and planning cadastre. The multipurpose cadastre accesses its data for many map production tasks.The integration of survey data in GIS through the use of ArcGIS Survey Analyst has made it possible for cadastre agencies to integrate survey data, cadastre data, and other layers of spatial data (e.g., hydrography, topography, land use, and land cover). New spatial data can be added with quality assurance tools to ensure accuracy.



Maintaining local land records in GIS saves money by automating map maintenance, speeding the enrollment of new parcels, and reducing valuation challenges.

National Cadastre GIS Extends to National Spatial Data Infrastructure

Case Study—Belgium

The Belgium national cadastral system is maintained by the Patrimony Documentation Department. It contains the records of the country's 9.4 million land parcels and one million registered strata or condominium units. This cadastre was initiated more than 200 years ago during the French Revolution. At that time, the "constituante" (the Constituante Assembly) created the land tax and, consequently, the general cadastre and established procedures for governing land information.

Today, Belgium's land information uses ESRI's ArcGIS software in a newly implemented cadastral map system called CADMAP. The system was born from the Belgium government's strategic plan for the modernisation and unification of its cadastre and lands registration agencies, a task requiring innovative technology.

The cadastral mapping system is used to

- Update and manage vector cadastre map files.
- Improve the quality of local cadastre maps.
- Provide online access to cadastre data.
- Support the spatial data infrastructure for a national cadastre GIS.
- Support national call centers and e-government through Belgium's Centre de la Communication de la Fiscalite Federale (tax office).

The Federal Public Service (FPS) Finance worked with ESRI BeLux to design a system that uses ArcGIS. FPS Finance customised the GIS to meet the national cadastre's goal to provide GIS services to approximately 10 provincial cadastre offices and 300 local survey offices. Components of the ArcGIS suite—ArcView, ArcSDE, and ArcIMS—have been incorporated into CADMAP.

Local offices, responsible for creating and updating the local plans and submitting updates to the provincial offices, use ArcView in their plan designs and presentations. Attributes include cadastral boundaries, parcel numbers, buildings, administrative boundaries, streets, rivers, bridges, parcel monuments, municipality monuments, and others.

Provincial offices use ArcGIS Survey Analyst to store and manage their survey measurements in the geodatabase. GIS technicians use this survey software to store survey measurements to improve the accuracy of their data.

Managing a database with 39,000 cadastre map sheets is a challenge. FPS Finance uses ArcSDE, a robust spatial data server, to provide a gateway for storing and managing spatial data in its database management system.

CADMAP georeferences and reorganises cadastral map sheets and creates one seamless cadastral geodatabase managed by ArcSDE.

The tax office needs to provide citizens with Internet access to tax office requirements and information. Internet map server software ArcIMS is used to support interactive, Web-enabled geographic information on the Web site.

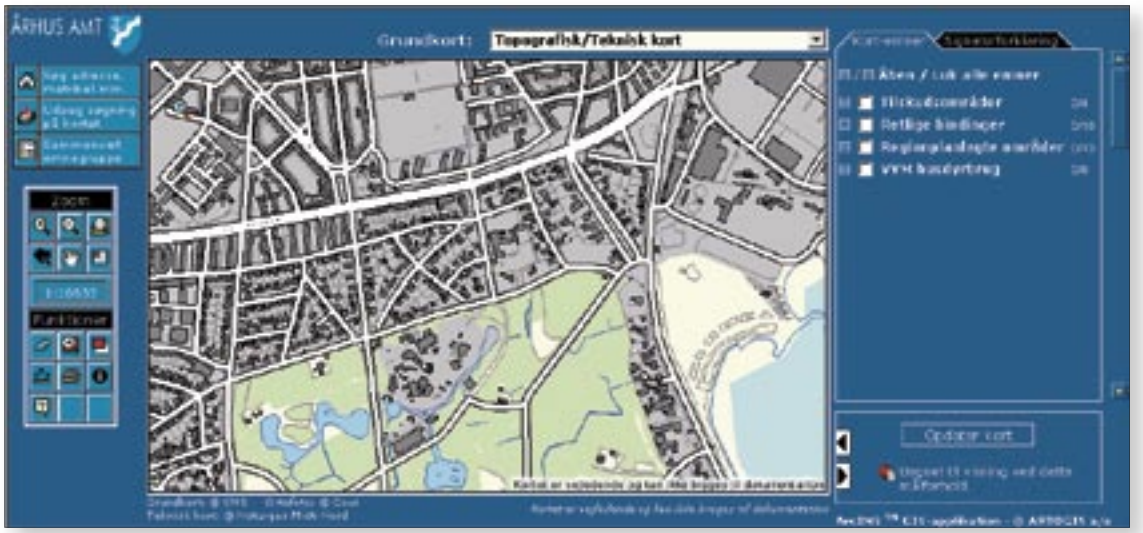
Belgium's CADMAP application is the foundation for establishing an e-government framework that integrates related users such as notaries, banks, loan agencies, communities, and cities. It provides efficient, prompt access to land data throughout the country.

The national cadastral files will eventually be linked to databases such as Belgium's inventory of the property of the state, water management districts, polders (lowland protected by dikes), Natura 2000 Network, and others.

ArcMap™ accesses parcel identification information.

Infrastructure data sets are used to create comprehensive thematic maps.

E-Government Delivers Land Records Information



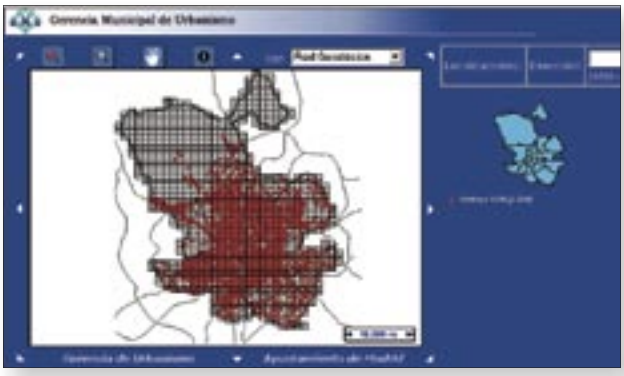
Danish ArcIMS Portal

E-government is a means of using Internet and GIS to create a more effective government. Typically, land records information is the most requested type of government information. The combination of readily available Internet access and maps allows governments to provide a new level of service, particularly access to parcel information, to businesses and the public.

E-government is making collaboration between government agencies possible in new and powerful ways. The strong data integration abilities of GIS allow governments to capitalize on data existing in legacy systems.

GIS-enabled Web sites can provide land-related services such as agriculture parcel subsidy submission. Three categories of e-government applications have been developed—government to business, government to citizens, and government to government.

The Flemish Land Agency Department Support Centre GIS—Flanders uses its GIS Web site to provide multireferenced data sets. This service stimulates collaboration among several government levels.



City of Madrid has a GIS-enabled Web site for public use.

Land Parcel Identification System Supports Agriculture Income

Orthophotography maps with verified LPIS data are scanned and processed as transparent layers directly in the GIS. LPIS includes information about internal borders. Attributes are appended in the database.

Case Study—Republic of Slovakia

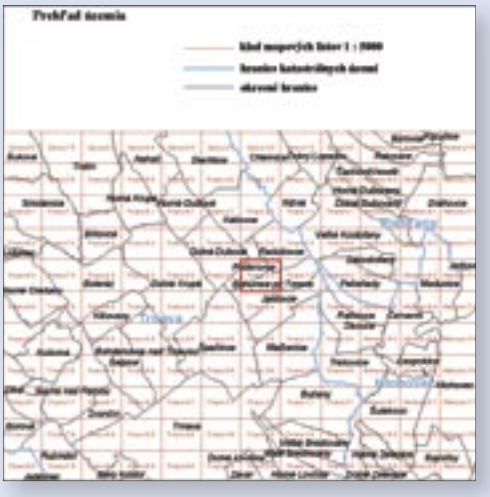
The Republic of Slovakia's Land Parcel Identification System (LPIS) is administered by the Ministry of Agriculture as part of its Integrated Administration and Control System (IACS). An important goal of Slovakia's Ministry of Agriculture is to qualify for subsidies issued by the European Union (EU), which mandates aerial and satellite images of subsidies linked to agricultural land. The EU subsidizes 350,000 farmers across Slovakia. An outflow of this is that Slovakia is also able to use the imagery to produce a topical list of parcels. Georeferenced aerial images of these parcels are stored in a geodatabase, which is managed and manipulated using GIS.

The Ministry of Agriculture's Slovakia Soil Science and Conservation Research Institute (SSCRI) was tasked to develop the LPIS to meet IACS' mandates and ensure compliance for EU subsidy regulations. The SSCRI contracted with ArcGEO Information Systems s.r.o., the local ESRI representative, to build the LPIS architecture. This architecture includes ArcGIS Desktop, ArcSDE, and ArcIMS.

In the first phase of the project, aerial photography was collected and digitized. A staff of 32 specialists managed the data collection. GIS operators from the Regional Departments of Agriculture delineated the physical blocks according to natural boundaries. For subsidy compliance, attribute relationships were defined by user relationships rather than owner relationships. Staff also managed extensive field verification with farmers to confirm geographic extents, land use, and property ownership. Throughout the digitizing process, checks were carried out for operator quality ensuring that the national agriculture parcel foundation was the most accurate possible.

The LPIS database digital orthophotography maps must be less than five years old to be considered valid for compliance. Therefore, much of the country needed to be photographed. This task was performed by the companies Eurosense and GEODIS. Photo flight timetables were documented and mapped by geographic regions. Aerial images were orthorectified with a GIS model that included interactive break line detections, which ensured that the required geometric parameters of the digital orthophoto maps and related LPIS blocks were used.

LPIS is built on an ESRI platform with principal components of ArcView, ArcEditor™, and ArcSDE. Data is stored in an Oracle database. Staff maintains the database by verifying, scanning, and processing orthophotos in GIS. The SSCRI also adds data about terrain characteristics, soil types, and crop information submitted by farmers.



Orthophotos are combined with surveying coordinates within each parcel. GIS identifies parcel attributes and owner.

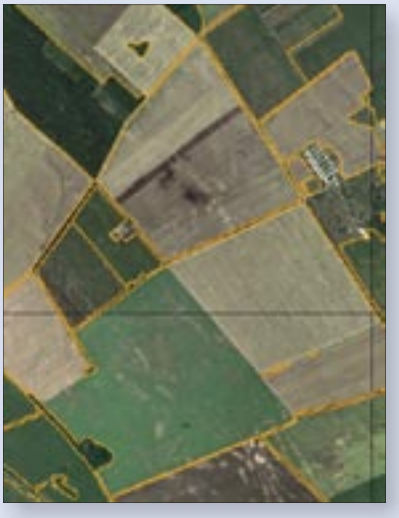
LPIS registers both parcel and agricultural data. In addition to attribute layers indicating ownership information, GIS produces themes that include terrain, water bodies, infrastructures, soil types, and topographic data.

GIS supports IACS crop registration mandates and performs subsidy calculations based on IACS criteria. Because GIS is database driven, IACS' subsidy tables can be imported and used to build a calculation model that includes geographic, crop, and monetary factors. The user can join tables to parcel feature classes and save joined data as thematic layers. GIS models can be built to perform calculations for subsidies, valuations, taxations, development, and so forth. Applications under development include the design of an object data model for the LPIS database and a project covering data integrity and synchronization with the database of the Agricultural Paying Agency.

With its landownership well documented in a relational database, Slovakia's Ministry of Agriculture has an efficient agriculture tool that is useful for more than just meeting IACS' requirements. ArcGIS applications can plan pesticide application, monitor animal health, assess flood risk, estimate insurance, and so forth. The present users of LPIS are farmers and civil servants who manage and control the development of Slovak agriculture. Other ministries in Slovakia will find that the same database can be used in a variety of administrative areas.

Mountain Regions

IACS Category Blocks, Terrain Characteristics, and Soil Typology



Orthophoto of Lowland Region

A Framework for Cadastre Management

Click on parcel to see specific title information.

Working with a community of land records managers and business partners, ESRI makes GIS data models available for cadastre and land information GIS. Data model templates make GIS more accessible to smaller organizations with limited budgets by providing a practical template for implementing GIS projects for a specific application or industry.

ArcGIS Parcel Data Model

Cadastre managers and GIS professionals can use the ArcGIS parcel data model as a starting point for defining parcel information and for planning migration strategies from existing data designs to a geodatabase environment. The data model provides a quicker, less expensive solution to data migrations, the longest and costliest part of a GIS project. Decision makers can apply the model to integrate landownership information with other data. Land and GIS professionals can apply the definitions and structure of the model to establish consistent and representative parcel information for data distribution. The purpose of the ArcGIS parcel model is to describe parcel information to support local government and private sector decision making. ESRI's ArcGIS software supports and is compatible with the Cadastre 2014 Data Model as outlined by the International Federation of Surveyors. Visit www.esri.com/argisdatamodels for more information.

International Federation of Surveyors

The International Federation of Surveyors (FIG) is a nongovernmental organization whose purpose is to support international surveying in all fields and applications. FIG has been quite strong in establishing survey data standards including standards for geospatial data cadastre survey mapping. ESRI is a corporate member of FIG and works with members to bridge the gap between surveying and GIS professionals. Based on FIG's Cadastre 2014 concepts, scholars and cadastre practitioners worked to create a sample Cadastre 2014 Data Model. This model represents the basic legal framework for land matters with an open and flexible object-based data model. While the model is general and flexible, the unique needs of a variety of land administration and land management users can adapt it easily to the legal environment of their jurisdictions.

The Cadastre 2014 Data Model will be used to create maps that show the complete legal situation of land including public rights and restrictions.

Acquiring and Integrating Data

ESRI GIS solutions offer the ability to incorporate a wealth of data sources from inside and outside an organisation. Data available from central and local agencies can be obtained at low cost or through data sharing agreements with other jurisdictions.

Legacy data sets can be joined with others for use outside the specific department in which they were created.

Internet Portals

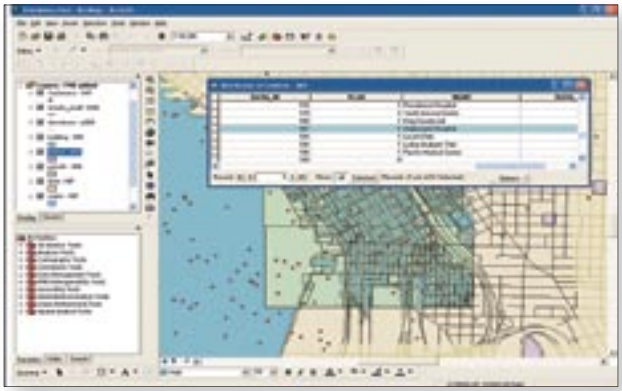
Spatial data portals allow people to publish, share, and use geographic data and services on the Web. They are made available to private, public, and commercial users; data publishers; service providers; and developers around the world. Content may be provided in the form of data, maps, or more advanced services and solutions. For example, those interested in economic development data can access ESRI's Geography Network℠ (www.geographynetwork.com) to find data about streets, demographics, boundaries, points of interest, and business listings.

ESRI's GIS Portal Toolkit provides all the necessary tools and templates to create a GIS portal. GIS Portal Toolkit is a technology and services solution for implementing local, regional, national, and global spatial data infrastructure (SDI) portals. GIS portals organize content and services such as directories, search tools, community information, support resources, data, and applications. They provide capabilities to query metadata records for relevant data and services and link directly to the online sites that host content services. The content can be visualized as maps and used in geographic queries and analyses.

The flow of information from the service provider to the user via a GIS portal

Data Interoperability Extension

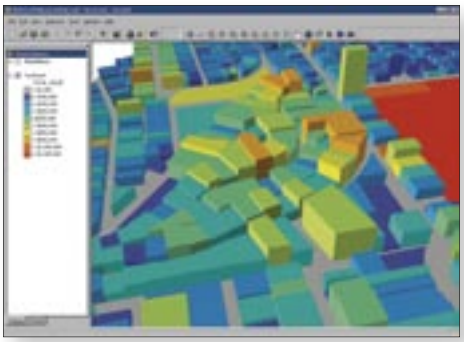
The ArcGIS Data Interoperability extension eliminates data sharing barriers by providing direct data access, complex data transformation, and import/export capabilities. The extension allows GIS professionals to easily integrate data from multiple sources, organizations, and formats. ArcGIS Data Interoperability allows GIS professionals to use standard GIS data within the ArcGIS Desktop environment, regardless of the format. This means that users can directly read, display, and analyze this data using all tools available within ArcGIS Desktop.



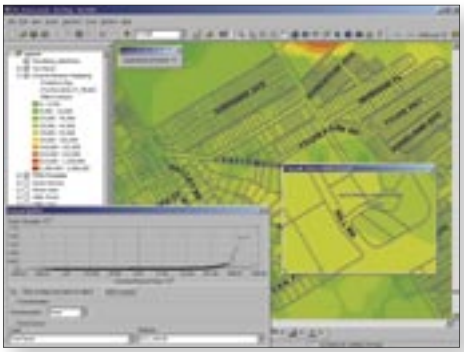
Use the ArcGIS Data Interoperability extension to read more than 70 data formats.

ArcScan for ArcGIS—Converts raster scans of parcel maps into vector-based geodatabase feature classes

ArcGIS Spatial Analyst—Advanced spatial analysis using raster and vector data to model the influence of location-specific data on value



ArcGIS 3D Analyst—Three-dimensional data visualization and topographic analysis



ArcGIS Geostatistical Analyst—Statistical tools for data exploration, modeling, and advanced surface creation

ESRI's GIS Tools for Enterprise Cadastre Management

- ArcView focuses on comprehensive data use, mapping, and analysis.
- ArcEditor adds advanced geographic editing and data creation.
- ArcInfo is a complete, professional GIS desktop containing comprehensive GIS functionality including geoprocessing tools.

These optional extensions dramatically extend the functional capabilities of ArcGIS for cadastre management.

ArcGIS Spatial Analyst	Advanced spatial analysis using raster and vector data
ArcGIS 3D Analyst™	Three-dimensional visualization, topographic analysis, and surface creation
ArcGIS Geostatistical Analyst	Statistical tools for data exploration, modeling, and advanced surface generation and valuation analysis
ArcGIS Survey Analyst	Integration and management of cost survey measurements in GIS
ArcScan™ for ArcGIS	Raster vectorization and simple raster editing
ArcPad	Mobile GIS software for data collection in the field
ArcGIS Data Interoperability	Use of any standard GIS data within the ArcGIS Desktop environment, regardless of the format
ESRI GIS Portal Toolkit	Tools and templates to create a GIS portal

Server GIS

- ArcSDE is an advanced spatial data server, providing a gateway for storing, managing, and using spatial data in a DBMS for any client application (e.g., ArcIMS or ArcGIS Desktop).
- ArcIMS is a scalable Internet map server. It is widely used for GIS Web publishing to deliver maps, data, and metadata to many users on the Web.
- ArcGIS Server is a comprehensive GIS server platform for enterprise and Web application developers. It is used to build distributed and multitier enterprise information system configurations based on ESRI ArcObjects™ core technology.

ESRI Business Partners Provide Cadastre Solutions

ILS

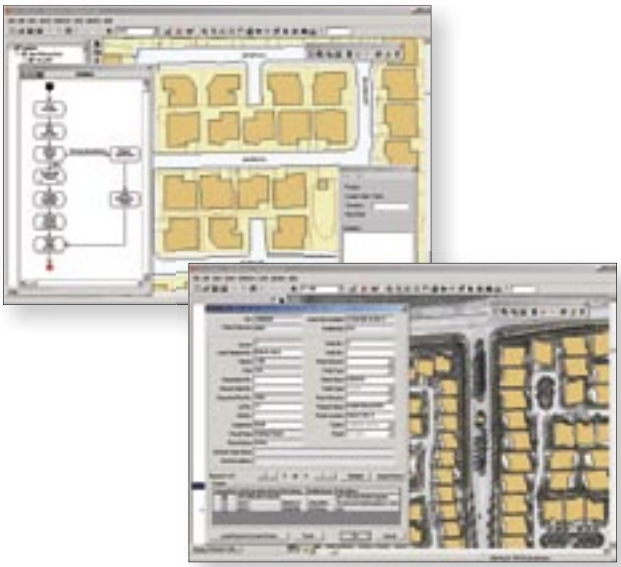
International Land Systems, Inc. (ILS), has developed innovative software tools and methodologies for cadastre management. ILS Land Titles Office and Land Register System tools address the challenge of land tenure and administration on more than 54 implementations worldwide. ILS also focuses on systems design and implementation for land administration including land (title) registration systems, land records (deeds registry) systems, back file titles (legacy data), and deed conversion. ILS provides a full range of professional consulting services to support land administration systems worldwide. These services include business process analysis, system design, system installation, data conversion, and a full range of training programs. For more information visit **www.landsystems.com**.

Lantmäteriet

To meet the needs of the rapidly expanding cadastral market, Lantmäteriet (National Land Survey of Sweden) and ESRI have developed ArcCadastre. ArcCadastre is basic cadastral software that contains the greater part of the functionality common to the cadastral work flow in different countries. It takes into account the legal requirements for handling this type of information. This cadastre system is built on ESRI's ArcGIS and includes survey functionality with ESRI's ArcGIS Survey Analyst and format conversion with Safe Software's Feature Manipulation Engine. Numerous extensions and customizations, united in one package, were developed with the expertise of Lantmäteriet. For more information visit **www.arccadastre.com**.

NovaLIS Technologies

Established in 1992, NovaLIS Technologies designs and delivers software solutions that streamline land records management and improve access to information relating to property valuation and taxation, land tenure, cadastral mapping, permitting, and land use planning. ESRI, ESRI Canada, and Leica Geosystems jointly own NovaLIS. NovaLIS' corporate headquarters are in Charlotte, North Carolina, and Halifax, Nova Scotia. NovaLIS is committed to providing land and government agencies with outstanding business solutions. Through its network of partners, NovaLIS works with corporations, agencies, and national, regional, and local governments worldwide. For more information visit **www.novalistech.com**.



This is an example of an integrated cadastre (ArcCadastre software) and land registry (ILS software) application.

NovaLIS technology is fully integrated with ESRI's ArcGIS, ArcView, and MapObjects® software.

For more than 35 years ESRI has been helping people manage and analyze geographic information. ESRI offers a framework for implementing GIS technology in any organization with a seamless link from personal GIS on the desktop to enterprisewide GIS client/server and data management systems. ESRI GIS solutions are flexible and can be customized to meet the needs of our users. ESRI is a full-service GIS company, ready to help you begin, grow, and build success with GIS.

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